Progress *in* Science

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Abstract

In contemporary literature, philosophers tend to treat progress and aim as closely related concepts. Accordingly, scientific progress is often defined as achievement of the aim of science. Problem: different pockets of science have different aims. To solve this, one approach argues that these diverse aims are reducible to a single *constitutive* aim of science, while another tries to redefine scientific progress *without* aims. I will argue that a conceptual shift from "scientific progress" to "progress *in* science" resolves the apparent tension between these two approaches and it encourages *normative* discourse that is of substantive importance to the question of progress.

1. Introduction

In contemporary literature, philosophers tend to treat progress and aim as closely related concepts. For example, Larry Laudan says that "progress makes sense only if it is progress toward the satisfaction of a goal or aim" (Laudan 1986, p.64). Accordingly, *scientific* progress is often defined in terms of the aim of science. For example, Alexander Bird claims that: "If the aim of science is knowledge…then scientific progress is a matter of accumulating more scientific knowledge" (Bird 2023, p.12). However, a look at actual science reveals a plethora of aims: academic science typically—but not exclusively—have epistemic aims like knowledge and understanding, while industry science, medical science, and military science more often have practical aims like profit, effective treatments, and destructive weapons. There seems to be no single aim of science.

To this problem of diverse aims, philosophers have responded in two ways. On the one hand, some argue that the diverse aims spread across different laboratories, disciplines,

sectors, and so on, can all be explained by a *constitutive* aim of science, i.e., an aim that (partly) *defines* science. For instance, Alexander Bird (2023) and Jacob Stegenga (2026) both argue that the constitutive aim of the scientific *institution* is some sort of knowledge. On the other hand, other philosophers, such as Finnur Dellsén (2025) and Insa Lawler (2025) argue that there is a more fundamental problem with the assumption that progress must be defined in terms of aims. Let us call the former group the conservatives and the latter the reformers.

On first look, there appears to be a large gulf between these two approaches: one wishes to retain the intuitive link between progress and aim despite difficulties in specifying what it means for science to have an aim, while the other wants to look at scientific progress anew, and with it, the tantalizing possibility of a renewed research program on what it means for science to progress. As with most debates in philosophy the convictions of one side are seen as fundamental mistakes from the other side. To the reformers, the conservatives' interminable debate over the aim of science looks like a research program on progress that is itself not progressing. But to the conservatives, the reformers' new research program—often called atelic progress or aimless progress—has so far produced only suggestive metaphors like progress *from* (in lieu of *to*) and no precise definition of scientific progress. Stuck between an approach that has failed to deliver the goods and a speculative alternative, it is difficult to see how we should proceed.

In this paper, I will argue that despite appearances, there is a middle-of-the-road approach that can satisfy both conservatives and reformers. Here is the big picture idea: both sides of the debate have been using "scientific progress" as if it were a *special* type of progress, distinct from say, philosophical progress or moral progress. But this is a misleading way to frame progress, because there is fundamentally only one notion of progress, namely, getting closer to or achieving an aim—the *type* of aim achieved (scientific? philosophical? moral?) is a separate question. Taking the road of compromise will mean that conservatives must abandon their search for the constitutive aim of science while reformers must resist the temptation to abandon the intuitive, aim-based view of progress. If we can do these, then there is a clear path forward: instead of thinking about X-type progress, we should think of progress *in* X-domains. The absence of a constitutive aim of science implies that there is no *scientific* progress, but there remain non-constitutive aims in science, which when achieved,

can be progress *in* science. An important lesson in this shift from scientific progress to progress in science is that the former leads us to probe the *metaphysics* of progress, e.g., "What distinguishes X-aims from non-X aims? Does X-type progress imply aims?" while the latter pushes us toward *normative* questions: "Which aims are *good* in X-domain? *What* makes some aims good and others bad?". As we shall see, both conservatives and reformers have been unduly distracted by metaphysical debates and failed to engage in normative discourse that is of substantive importance to the question of progress.

This is the plan: in section 2, I will show how the tension between the conservative and reform approaches can be dissolved; in section 3, I will explain in more detail how the conceptual shift from scientific progress to progress in science helps point us towards more productive avenues to understand progress; lastly, I will conclude in section 4.

2. The middle-of-the-road approach

Before showing that the conservative and reform approaches are compatible, we might ask: Why attempt to satisfy both? Why not stake my position on one side? I seek a compromise between conservatism and reform because each side has virtues but also problems. For the conservatives, their virtue is that they retain the intuitive idea that progress is fundamentally about getting closer to or achieving an aim. Not only is an aim-based conception of progress intuitive but aims also provide a simple explanation for the *normative* aspect of progress that sets it apart from mere change. Consider a suggestive example. During the process of baking a chocolate cake, its ingredients undergo various changes: the chocolate is melted, the flour is sifted, the egg whites are whipped, and so on—here, the episodes of change are also episodes of progress toward producing a chocolate cake. But baking is not mere change, for if the egg whites were scrambled, the chocolate frozen, and the flour whipped, we would end up with a pile of mess rather than a chocolate cake—the episodes of change here would be regress, not progress. The possibility of regress shows that progress is *directional*, and aim is what provides this directionality: doing things that gets me closer to my aim of baking a chocolate cake is progress; doing things that take me further away is regress. Aims 'orient' progress against regress, so to speak.

However, the conservative approach also faces great difficulties. As mentioned, philosophers in this camp have tried to reduce the diverse aims spread across different pockets of science to a single constitutive aim of science. One problem with this is that there seems to be interminable debate between philosophers on what the constitutive aim of science is, even though there seems to be general agreement that it is something cognitive, such as knowledge, truth-likeness, understanding, and problem-solving (for surveys of these views, see Shan 2023 and Rowbottom 2023). Experimental philosophers have contributed by conducting empirical experiments to test peoples' intuitions, but even these have produced only suggestive evidence (e.g., Mizrahi and Buckwalter 2014). Against this stalemate background, some philosophers have tried to clarify what it means for science to have an aim. The earliest effort I am aware of is from David Resnik who considered different explications, including shared goals, normative ideals, corporate goals, and definitions of scientific method, but found all of them wanting (Resnik 1993). Building on Resnik's efforts, Darrell Rowbottom argues further that not only is aim-talk difficult to make sense of but in the context of the scientific realism debate, it creates more confusion than clarity and so should be avoided (Rowbottom 2014).

To be sure, Bird (2023) and Stegenga (2026) have more recently provided helpful clarification by suggesting that "the aim of science" be understood as the aim of the scientific *institution* (which they claim is knowledge and common knowledge, respectively). My own position is that epistemic aims—including knowledge—face especial difficulty in accounting for the practically oriented sciences, such as clinical medicine, military research, and industry science (see also Elliott 2013 and Potochnik 2015). It will take us too far afield to argue for this in detail, but the idea to appreciate is that the sheer range of aims, practices, and activities found across different pockets of science is so broad that it is difficult to see how they can all be neatly explained by any single aim, or even set of aims—there is *irreducible diversity* in science, and thus little hope that the constitutive aim approach will succeed.

This brings me to the reformers, whose virtue is their recognition that there is no constitutive aim of science, and this motivates them to redefine scientific progress without aims. Roughly, the idea is this: at first, we assume that to understand scientific progress, we must first identify the aim of science, but now we learn that there is no aim of science, and so

we conclude that scientific progress—which we are unwilling to reject—must be redefined without aim. For example, Dellsén had in the past defined scientific progress in terms of the aim of science: "X is the aim of science just in case science makes progress when X increases or accumulates" (Dellsén 2016, p.73). However, more recently, Dellsén is convinced by Resnik's and Rowbottom's arguments and now thinks that "science has no aim(s) [but] what constitutes scientific progress is not determined by what science aims for, so it doesn't matter to the scientific progress debate whether science aims for anything at all" (Dellsén 2025, p.2). Accordingly, reformers like Dellsén attempt to solve the aims problem by defining scientific progress using non-aims vocabulary; for example, Insa Lawler suggests that "from a conceptual point of view, [scientific progress] does not need any aims or goals. We only need standards/criteria to measure the improvements" (Lawler 2025, p.7). My own position is that these arguments are often a result of conceptual confusions, most importantly (as we shall see) a conflation of aim and *telos*. Still, it will again take us too far afield to respond to all these arguments. For now, I hope that the *prima facie* motivation provided above—that aim-based progress is intuitive and that aims explain the normativity of progress—suffice at least to show that we should not abandon aims so quickly.

In short, a compromise is desirable because there is much to like about both the conservative and reform approaches. But a compromise also appears elusive, for the two approaches seem to be in tension: with regards to the broader project of explicating scientific progress, the reformers suggest that we turn away from aims but the conservatives say that aims are essential to defining progress. This is why the conservatives and reformers appear to be at loggerheads, for each are committed to claims that seem clearly in tension. However, it turns out that the conservative and reform approaches are not strictly incompatible, for there remains a possibility of an aim-based account of scientific progress even if one holds that there is no aim of science. To see this, it will help to analyze a particular case in detail, and for this purpose, there can be no better candidate than Philip Kitcher, who has over decades written extensively on science and progress. Kitcher's account of scientific progress is especially illuminating as his earlier view was clearly aim-based—thus, he was a conservative—but in recent years, Kitcher's view changes and he develops a new view of progress that *appears* to suggest that he has become a reformer. However, as we shall see, although there is a significant change in Kitcher's account of progress, *it nevertheless retains*

an important role for aims. In Kitcher's earlier work, his account of scientific progress was explicated using aims-related vocabulary:

> The account [of scientific progress] that follows will presuppose that there are goals for the project of inquiry that all people share—or ought to share. The varieties of progress I describe will be understood in terms of the greater achievement of these goals (Kitcher 1993, p.92).

Further development of this idea can be found in Kitcher's 2001 book *Science, Truth, and Democracy*, where he proposes the idea of well-ordered science, according to which the aims that should be pursued in science are to be determined by an inclusive conversation among ideal deliberators:

> For *perfectly* well-ordered science we require that there be institutions governing the practice of inquiry within the society that *invariably* lead to investigations that *coincide* in [agenda setting, strategies of pursuit, and translation of results] with the judgments of ideal deliberators, representative of the distribution of viewpoints in the society (Kitcher 2001, p,.122-123, original emphasis).

However, by 2015, Kitcher tells us that his earlier view of progress—which quite clearly featured the intentions of ideal agents—has changed:

> Teleology is hard to resist. Like many other philosophers, I once believed that the right way to respond to Kuhn's concerns was to adapt the goals of science to his insights…it's fairly obvious that this notion is problematic…*The root trouble lies in conceiving scientific progress as teleological*. (Kitcher 2015, p.482-484).

Kitcher himself tells us that teleology is the reason for the change. This suggests that his earlier view defined scientific progress in terms of *telos*, which is an Ancient Greek word that is usually translated to "end", "purpose", or "goal". Note that an important meaning is lost in translation here, namely that concepts like aim and goal are typically taken to be some sort of

psychological state—an *intention*.[1] In contrast, an Aristotelian understanding of *telos* is something like an "inherent purposive or goal-directed *force*", for example, the front teeth of carnivores are said to possess an inherent force that makes them grow sharp (Ariew 2007, p.162, added emphasis). To be sure, Plato's teleology involves intentionality, but it is specifically the intention of a divine craftsman called "Demiurge" (Zeyl and Sattler 2023), rather than the intentions of non-supernatural agents.

Having distinguished aim and *telos,* it is difficult to see how Kitcher's earlier view on scientific progress should be affected by teleology. After all, it is one thing to say that agents engaged in scientific inquiry should have certain aims, and quite another to say that science has a *telos*—and of course, Kitcher's earlier view is an instance of the former. Clearly then, Kitcher is using "teleology" differently from Aristotle or Plato. What then is teleology for Kitcher? Unfortunately, there is some inconsistency in how Kitcher uses the term. Sometimes, he seems to think of teleological progress as an explication of progress that involves aims or goals *at all*:

> Many people think of progress as teleological: it is always progress *toward a goal* [where] the destination is specified in advance and progress consists in coming ever closer to it (Kitcher 2021, p.24-25, added emphasis).

If teleological progress just is aim-based progress, then Kitcher's rejection of teleology will straightforwardly make him a reformer. However, a closer reading of Kitcher's work reveals that his problem with teleology is not so much that it involves aims but the idea that these aims are *definitive* or *fixed* in some sense:

> Stepwise pragmatic progress is guided by *local* goals. At each stage, the aim is to find relief from a problem or from a limitation felt as confinement. The break with teleology

[1] To keep things simple, I will focus on the aims of individuals. For group aims, social ontology theories enable ascription of intentions to groups (e.g., Schweikard and Schmid 2020). For entities lacking intentions, such as organizations, we may liberalize the definition of aim accordingly: e.g., Herbert Simon defines "organizational goal" as "constraints, or sets of constraints, imposed by the organizational role" (Simon 1964, p.1)—but even these would still be conceptually far from *telos*.

> consists in the absence of any goal *guiding the whole sequence of transitions* (Kitcher 2021, p.25, added emphasis).

On this reading, teleological progress is not equivalent to aim-based progress, but more precisely, it is *constitutive* aim-based progress—that is, defining progress in terms of constitutive aims rather than any aim whatsoever. Thus, Kitcher's rejection of teleology does not necessarily make him a reformer in the context of scientific progress, for the claim that science has no constitutive aim of science does not imply that there are no non-constitutive aims in science. Evidence that Kitcher has not entirely abandoned aims can be found in his go-to example of the pianist:

> The aspiring pianist makes progress…[she] improves her technique by smoothing out her uneven trills and advances her interpretive sensitivity by understanding the structure of the pieces she plays (Kitcher 2021, p.25).

Although Kitcher does not make this sufficiently clear, his references to the pianist's "aspirations" and "improvements" are merely paraphrases of the idea that *the pianist's progress is to be understood as the achievement of her aims* to smooth her uneven trills, to advance her interpretative sensitivity, and so on. Thus, far from being a reformer, Kitcher's pragmatic progress retains the intuitive idea that progress is fundamentally about the achievement of aims. In the context of science, Kitcher also retains a place for aims, even though he rejects the idea that there are constitutive aims of science. In his 2015 paper, Kitcher explains his realization that "it is fairly obvious that [his earlier view of scientific progress] is problematic", because "How do you do the accounting?" (Kitcher 2015, p.483). What Kitcher is saying here is that even if we successfully define a set of aims for science, it remains unclear how we can give an overall judgement of progress, since in any given episode there might be advancement in some aims but retreat in others. Thus, Kitcher realizes that his earlier view is problematic in that there seems to be great difficulty in specifying a *definitive* set of aims that should be pursued *in all possible contexts.* Accordingly, his solution was to refine his account of scientific progress towards *local* aims:

> Scientific progress is a species of pragmatic progress. The sciences progress by addressing significant questions, and the questions obtain their significance from the challenges faced by particular groups of people, living in particular environments, with particular social and cultural legacies (Kitcher 2015, p.489).

The upshot here is that Kitcher's discussion on teleology is somewhat misleading. Firstly, *telos* has roots in Ancient Greek philosophy, and these carry metaphysical implications that are unwanted in present discussion. Secondly, Kitcher was not consistent in specifying whether his understanding of teleology is that it involves any aims whatsoever or more specifically, constitutive aims. A charitable reading of Kitcher's work reveals that his problem with teleology (as he understands it) really concerns constitutive aims rather than aims *per se*. In the context of scientific progress, the substantive change in Kitcher's view is thus a rejection that science has constitutive aims, and in its place, an affirmation of local aims. In these regards, Kitcher is both partly a conservative and a reformer—*yet there is nothing inconsistent about his account of scientific progress*. Putting it all together, we can finally appreciate how the conservatives' and reformers' virtues can be combined: the conservatives are to be commended for insisting on the intuitive link between progress and aims, but the reformers are right that there is no constitutive aim of science—thus, the tension between these two approaches is resolved in that scientific progress should be defined in terms of the achievement of *non-constitutive* aims.

3. From scientific progress to progress *in* science

Resolving the tension between the conservative and reform approaches gets us closer to an explication of scientific progress—we have made some progress, so to speak. However, we are still far from a complete definition, for the achievement of non-constitutive aims is necessary but not sufficient for scientific progress. It is not sufficient because the aims achieved may be trivial, or worse, bad. The idea that trivial science does not contribute to progress is behind the former Wisconsin senator, William Proxmire's infamous Golden Fleece Awards. From 1975 to 1988, the crafty senator issued 'awards' to "the most outrageous example of federal waste" in a given month, and scientific projects authorized by federal scientific institutions like the National Science Foundation were frequent targets (Proxmire 1980, p.1). To be sure, we need not agree with Proxmire's assessments of triviality, but the

point is that his underlying conviction that *not all aims in science are valuable* is surely correct.[2]

Accordingly, we should supplement our explication of progress to include the condition that the aims achieved must be valuable; and thus, progress is defined as the achievement of (or getting closer to) *good* aims while regress is the achievement of *bad* aims. The question then, is: what are good aims *in science*? In answering this, we must avoid the mistake of equating good aims in science with *scientific* aims—this was, after all, precisely the mistake made by the conservatives, from which we have learnt that there is no constitutive aim of science for us to directly infer what good aims in science are. To avoid this mistake, I propose that we reframe the debate from "scientific progress" which is common terminology in the literature, to "progress *in* science". This conceptual shift is meant to provoke a change in the sort of questions that we should be asking about progress. As seen from the contemporary debates, both the conservatives and reformers have been preoccupied with *metaphysical* questions about progress. The conservatives have been asking "What is the constitutive aim of science? How can it be reconciled with the diverse aims we observe in actual science?", while the reformers ask "Which types of progress are aimless? Is scientific progress aimless?". These questions emphasize "scientific" in "scientific progress": the conservatives seek to demarcate scientific aim(s) from non-scientific aims, while the reformers ask whether scientific progress is the sort of progress that is atelic or aimless. In contrast, my new framing shifts the emphasis towards "progress" in "progress in science", and this is meant to encourage *normative* questions like: "Which aims *should* be pursued in science? *What* makes some aims good and others bad?". The shift from scientific progress to progress in science is thus a shift from metaphysics to normative discourse.

To be sure, I do not mean to suggest that the conservatives or the reformers have entirely neglected the normative aspects of scientific progress. Kitcher's work on progress, for instance, has always been strongly motivated by normative concerns. Indeed, his earlier view of scientific progress clearly sought to answer what the aims of science *should* be. Still, we saw that Kitcher's later views became clouded by teleology, and this obscured the more

[2] Kitcher again: "Truth is very easy to get… what we want is significance and *not* truth" (Kitcher 1993, p.94).

important shift away from constitutive aims. Kitcher is not alone here, for recent work discussing scientific progress and the aim of science contain similar conflations of aim and *telos*, [3] and more generally, they have continued to focus on metaphysics. Although normativity is mentioned, they are very brief afterthoughts. For example, in a recent collection of articles in response to Darrell Rowbottom's 2023 book, *Scientific Progress* (Pedersen 2025), two out of five articles primarily argue that scientific progress does not require aims (Dellsén 2025 and Lawler 2025), and another argues that the scientific institution has a constitutive aim (Niiniluoto 2025). In other words, a majority of the articles in this series take either the conservative or reform approaches with regards to scientific progress.

My suggestion to shift to progress in science may probe worries that I am ultimately led back to the very problem I was trying to avoid, naming demarcating science from non-science. After all, progress *in* science implies that there is progress *outside* science; am I not therefore implicitly committed to demarcations of other kinds: such as between scientists and non-scientists, scientific institutions and non-scientific institutions, or scientific methods and non-scientific methods? But clearly, the objection goes, these demarcation projects—especially on method—are equally if not more controversial than aims-demarcation which I have tried to avoid. Am I not solving one problem by covertly reintroducing old problems? My response to this is that my account need not and indeed explicitly does not define "science" in any sense, be it *qua* agent, institution, or method. What my account does define is just "progress" in "progress in science"; and so, if I am committed to any demarcation at all, it is between good aims and bad aims. The "in science" or "outside science" part comes in only as convenient markers for when we discuss uncontroversial examples. For instance, no one will deny that Einstein was a scientist, and so it is uncontroversial that there was progress in science when he discovered General Relativity—i.e., a scientist's aim was achieved. But more importantly, one of the central motivations for shifting from a focus on metaphysics to a focus on normativity is that demarcations of science *stop mattering*. Even if we wish to discuss examples where there may be disagreement over whether a particular agent is a scientist or

[3] For example, although Lawler claims that "[a]ims or goals require *intentions* of some sort", which should signal a dissimilarity with *telos*, she nevertheless equates aim-based progress with teleological progress: "[a] concept of progress is teleological [if] we are measuring progress in terms of developments towards an *intended* endpoint or outcome" (Lawler 2025, p.5).

if an institution is scientific, resolving these controversies will get us no closer to evaluating progress, for we have entirely ignored the substantive question of whether the aims of these agents and institutions are *good* or *bad*. Here, I am channeling Larry Laudan's cogent advice—in the context of the demarcation problem—that the important question to ask is not whether a given method is scientific or not, but rather whether it has desirable epistemic properties (Laudan 1983). In this spirit, the important part of "scientific progress" is not "scientific" but rather "progress", and more specifically, it is the *normativity* of progress.

We have seen that Kitcher provided a pragmatist answer to the normative question of progress, but many other options remain open—we need only look at the extensive debates in value theory for inspiration. For example, Rowbottom offers an account of progress that is inspired by J.L. Mackie's error theory, where the 'goodness' of aims is cashed out entirely subjectively: roughly, an aim is good *for a given agent* insofar as they promote or constitute the agent's values (Rowbottom 2023, chp.3). Of course, all of these are controversial normative theories, but if philosophers disagree with Kitcher or Rowbottom, then their arguments should directly involve normative debates rather than be distracted by metaphysics.

4. Conclusion

The debates on scientific progress and the aim of science have taught us two important lessons. Firstly, there is no constitutive aim of science, and secondly, progress must be defined in terms of aims. The apparent tension between these two claims is dissolved once we appreciate that rejecting the view that science has a constitutive aim still leaves room for defining progress in terms of non-constitutive aims. Contra to contemporary literature, I have argued that there is but one notion of progress, and hence there is no such thing as *scientific* progress. However, there remains progress *in* science, which I have defined as the achievement of good aims in science—the task ahead is to figure out what these are.

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